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Role of Five Medicinal Plants (Giloy/Guduchi, Garlic, Tulsi, Turmeric and Ginger) in Human Immune System

Sherly, E. A., Prabhat Kumar, Pawan Kumar, Astha Tripathi*, Preeti Sengar and Sarita Tiwari
Department of Life Science, Singhania University, Pacheri Bari, Jhunjhunu, Rajasthan
*Director, Mycoera Pvt. Ltd., Dr. Ambedkar Institute of Tech. for Handicapped Incubation Centre, Kanpur

Abstract:- To strengthen the immune system, people must be urged to take vitamins and medicines. Medicinal plants are best source of bioactive compounds with therapeutic properties and are used by diverse groups of people for treatment of various diseases. The Vedas and Samhita contain numerous references to medicinal plants and their use, which originate from between 3500 BCE and 800 BCE. India is well known for its ethnobotanical endeavours. The "Vrikshayurveda," which is discussed in Vedic writings including the Atharvaveda and the Rigveda, is where the first mention of herbal medicine may be found. Ayurveda is a conventional herbal medicine practice, with roots in the Indus Valley between 3300 and 1300 BCE. The roots of the name are "Ayur" and "Veda," which combined denotes wisdom and life. According to recent studies on natural treatment, a variety of herbs have complex effects on immune function and act at various points in the entire cascade of immunological reactions. These herbs may function as significant immunity boosters. Generally speaking, we depend on plants and products derived from plants to maintain strong immune system. This study aims at providing a brief review on five well known medicinal plants of India.

Keywords:- *Medicinal Plants, Immunity, Phytochemicals, Immunostimulator*

I. INTRODUCTION

Immunity is referred to in Ayurveda as Ojas, or the body's resistance against illness. In Microbiology, Immunity refers to the body's ability to prevent the invasion of pathogens**.** Pathogens are foreign disease-causing substances, such as bacteria, virus, fungi and parasite. Some allergens can cause some allergic reactions. The defence system of our body plays an important role against a variety of illnesses or ailments. Natural products, especially those derived from plants, have been used to help mankind sustain human health. The immune system can stop harmful substances and neutralise illnesses when it is functioning properly. The immune system blocks the actions of invaders, which include a variety of microorganisms like viruses, parasites, bacteria, and fungus by acting through a complex network of innate and adaptive mechanisms [1]. Numerous studies have demonstrated that plant-derived natural chemicals can strengthen the immune system [2]. Medicinal herbs can exert their therapeutic benefits by promoting or repressing particular immune processes to restore the body's normal immune response to diseases. Humanity has used medicinal plants for their therapeutic properties ever since human civilization first emerged. For thousands of years, the natural world has served as a source for medical substances and a staggering number of contemporary medications have been separated from these sources. The reasons for many of these isolations were related to how the agents were used in conventional medicine. Herbal remedies are prepared from any component of a plant, including its leaves, flowers, seeds, roots, bark, stems and more. The Ayurvedic School of Medicine in India has documented numerous instances of such drugs created from plants or plant derivatives [3]. The Vedas, the sacred texts of India, discuss the use of herbs for healing. India is the home of many common spice plants, including nutmeg, pepper, clove, and others. The immune system defends the skin, nasal passages, intestinal tract, and other organs from external antigens like viruses, cancerous cells, poisons, and microbes [4]. Immunity is the healthy condition of multicellular organisms with sufficient biological defences to ward off disease, infection, etc. It is specifically the body's defence mechanism against any disorders or illnesses. This sophisticated immune system is composed of organs, tissues and cells that each have a particular role in the elimination of infections and other foreign invaders. Plants are used by humans because of their healing, regenerative, and immunomodulatory abilities [5]. Seventy thousand out of three lakh angiosperm plants have been used medicinally by people from various civilizations around the world [6]. Based on ethnobotanical research, it is believed that these medicinal and aromatic plants are better for therapeutic use since they are less toxic, more cheap and compatible with different cultures [7]. The focus of our study is on five medicinal plants which could strengthen the immune system.

II. MEDICINAL AND IMMUNOSTIMULATING PROPERTIES OF PLANTS

A. Giloy / Guduchi (Tinospora cordifolia):

Tinospora is a herb with heart-shaped leaves. It has long been used and recommended in Indian medicine. Fresh Giloy juice aids in boosting immunity [8]. It speeds up recovery by increasing the activity of macrophages, which are cells that fight against pathogens. The herb giloy is beneficial for boosting the immune system and the body's ability to fight against dinfections. It has anti-inflammatory and antipyretic (that lower fever) properties. [9].

Tinospora cordifolia commonly known as 'Guduchi' or 'Amrita', is a plant being used from centuries for its medicinal values. Ayurveda practitioners use the herb

tinospora cordifolia to boost the immune system [10]. *Tinospora cordifolia* supplements makes it simpler for immune system cells like macrophages to consume their prey [11]. Supplementation is a good way to avoid allergies. Many studies have reported the hypolipidemic, hypoglycemic, hepatoprotective, antibacterial, anti-inflammatory, antiosteoporotic, antiobesity, anticarcinogenic and antimutagenic properties of giloy [12]. Its antioxidant potentials were also investigated in many studies. It is also very effective against lead toxicity, diabetic foot ulcers and diabetic neuropathy. It also improves learning and memory power. This plant boosts energy and activates our bodies' immune systems [13]. It is rich in antioxidants and promotes the body's detoxification process. Giloy juice also enhances and detoxifies the skin. Giloy is also used to treat liver, kidney, and urinary tract infection problems [14]. The immunomodulatory properties of giloy was studied in various models, α-D-glucan, the main chemical constituent of giloy stimulate natural killer cells, B cells and T cells with simultaneous production of various immune-stimulatory cytokines [15]. It also reduces the total leucocyte count (TLC), neutrophil and eosinophil counts in HIV positive patients [16]. In a study done on male wistar rats using alcoholic extract of giloy showed an increase in the white blood cell (WBC) counts, bone marrow cellularity, serum IgG antibody concentrations which further validates the immunomodulatory potential of this plant [17]. *Tinospora cordifolia* has been used for its therapeutic properties for millennia [18]. Giloy's hypolipidemic, hypoglycemic, hepatoprotective, antibacterial, anti-inflammatory, anti-osteoporotic, anti-obesity, anticarcinogenic and antimutagenic qualities have been the subject of numerous investigations [19].

The immunomodulatory activity of *T. cordifolia* is due to the synergistic effects of compounds including low molecular weight alkaloids, clerodane diterpenoids, sesquiterpenoids and phenyl propanoids (magnoflorine, N-formylannonain, N-methyl-2- pyrrolidone, 11-hydroxymuskatone, cordioside, cordifolioside A, cordifolioside B, cordial, tinocordiside and syringin), a high molecular weight arabinogalactan named G1- 4A, 1,4-αD-glucan (RR1), and the enzyme thiol amylase [20]. Clerodane furano diterpenoid glycosides like cordioside, cordiofolioside A and cordiol were reported for their macrophage activation, which plays an important role in specific and non-specific immune responses [21]. Cordifolioside A is an active immunostimulant used in the quality control and standardization of the plant's formulations [22]. A cadinane sesquiterpenoid glycoside, tinocordiside, possesses immunomodulatory activity. The polysaccharide fraction from T. cordifolia effectively reduced the metastatic potential of B16F-10 melanoma cells due to its antioxidant activity towards DPPH and superoxide radicals [23].

It is believed that the Guduchi or Giloy herb contains a variety of diterpene compounds and polysaccharides, including arabinogalactan polysaccharide [24]. These terpenoids and polysaccharides have immunomodulatory and adaptogenic properties. Studies on Giloy herbal extract have shown that it can activate macrophages, induce cell-regulated immunity, and boost humoral immunity in addition to significantly increasing serum IgG antibodies [25, 26]. Moreover, several plant triterpenes such as dammaradienol, dammarenediol-II, hydroxyhopanone, dammarenolic acid, hydroxymarenone-I, ursonic acid, shoic acid, eichlerianic acid and hydroxyoleanonic lactone [26] play a vital role in the modulation of cellular metabolism [27].

B. Garlic (Allium sativum):

The Allium family of onions includes garlic. It is a fundamental component of the majority of global cultures [28]. If consumed in the proper manner, garlic has a tonne of health advantages. Because of its immunomodulatory and anti-inflammatory qualities, garlic serves as a herbal remedy [29]. Its many bioactive components and formulations have been well investigated. Antioxidants found in garlic boost the body's defences against oxidative damage. Garlic supplements at high doses have been demonstrated to considerably lower oxidative stress in persons [30]. Garlic Known for its immunomodulatory, antibacterial, anti-inflammatory, anti-mutagenic, and antitumor characteristics, *Allium sativum* is a good source of nutrients [31]. Its effectiveness against viruses was also proven. It contains many vitamins and minerals, including Vitamin B1, B2, B3, B6, folate, magnesium, phosphorus, sodium, zinc, iron, and calcium [32]. The presence of allicin, which aids in the treatment of numerous illnesses, is what makes garlic a wonderful immunity booster [33]. Garlic has promising uses in the creation of functional foods or nutraceuticals for the prevention and treatment of certain diseases since it is a great natural source of bioactive sulfur-containing chemicals [34]. There is a long history of the therapeutic and preventative use of garlic in traditional medicine. The anti-inflammatory and immunomodulatory effects of garlic or its many bioactive components and formulations have been thoroughly investigated in vitro and in vivo investigations [35]. On the one hand, direct guidance and stimulation of immune cells, and on the other, regulation of cytokine profiles, are two of the main methods seen. Compounds in garlic support the immune system's ability to combat pathogens [36]. Alliin is a substance that is present in whole garlic. This substance transforms into allicin the primary active component of garlic, when it is crushed or chewed [37]. Sulfur in allicin is what gives garlic its characteristic flavour and aroma [38]. However, because allicin is unstable, it quickly breaks down into other sulfur-containing substances that are regarded to be the source of garlic's therapeutic benefits [39].

The medicinal qualities of garlic are a result of the increased concentration of sulfur compounds in garlic (allicin, diallyl disulfide, S-allylcysteine, and diallyl trisulfide) [40]. It has a long history of being a helpful spice and a widely used remedy for a number of illnesses and physiological disorders [41]. Garlic's broad-spectrum therapeutic effects and minimal toxicity are of particular interest to scientists investigating its therapeutic characteristics. Garlic extract possesses antiviral, fungicidal, and antibacterial properties [42].

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Garlic has been found to have a variety of therapeutic properties, including actions that are anticancer, antibacterial, antiviral, antidiabetic, antihypertensive, cardioprotective, hepatoprotective, and hypolipidemic [43]. The fact that garlic may modify a number of biological processes in addition to its pharmacological effects has prompted many researchers to pay particular attention to the bioactive molecules of garlic's anti-inflammatory, antioxidant, and immunostimulant effects [44]. Garlic's formulations were used to increase immune functions (consequently of inflammatory and oxidative stress) may aid in the treatment and prevention of disease [45]. This is because some diseases can be brought on by immune dysfunctions and oxidative stress, which is frequently linked to a state of acute or chronic inflammation. Allicin, a component of garlic, has been shown to have antimicrobial properties against a wide range of microorganisms, including antibiotic-resistant, Gram-positive and Gram-negative bacteria like Shigella, Escherichia coli, Staphylococcus aureus, and Pseudomonas aeruginosa. Other bacteria that garlic has been shown to be effective against include Streptococcus mutans, S. Faecalis. It has been observed that several garlic extracts, including aqueous, chloroform, methanolic, and ethanolic extracts, can stop the growth of certain harmful bacteria. For instance, a study found that ethanolic garlic extract had a greater inhibitory effect than aqueous garlic extract did against E. coli and Salmonella typhi [46]. Garlic also prevents the toxins released when a bacterial infection occurs in addition to its antibacterial properties [47]. The flu, COVID-19 infection, and cold symptoms may be lessened by the antiviral property [48]. Garlic therefore boosts the immune system and helps fight off infections and other illnesses. Allicin, a versatile antibiotic will enhance immunological activity by igniting white blood cells involved in defence.

C. Tulsi (Ocimum sanctum):

Tulsi (Holy Basil) is known as "The Queen of Herbs" in India and is highly regarded for its capacity to promote physical, mental, and spiritual well-being. Due to the mystical qualities of this herb, a few leaves in food can purify and kill bacteria. Zinc and Vitamin C are abundant in tulsi. As a result, it boosts natural immunity and prevents the spread of illnesses. It contains powerful antiviral, antifungal, and antibacterial effects that shield humans against a range of ailments [49]. The juice of tulsi leaves can be used to bring down fever. Extract of tulsi leaves in fresh water should be given every 2-3hrs (Kothari *et.al.*, 2008) .Various portions of *Ocimum sanctum* have been prescribed for the treatment of various ailments in the traditional system of medicine [50]. Vitamin C, antioxidants, antiseptic, and antiviral activities are abundant in this herb. Due to its anti-microbial characteristics, tulsi is utilised as a natural hand sanitizer [51]. Tulsi tea is one of the most popular natural treatments for the common cold or sore throat. Due to its influence on the body's chemical changes, tulsi can aid in strengthening the respiratory system [52]. Through a special mix of pharmacological activities, tulsi has been proven to address physical, chemical, metabolic, and psychological stress [53]. Tulsi, or the holy basil holds a prominent place in Indian Hindu culture and traditions. It is used on almost all religious occasions and is often presented to the Gods in the form of garlands (Desi wisdom online, 2018). Tulsi consumption enhances immunity [54]. Tulasi is a fantastic option to ward off respiratory illnesses because of its antibacterial qualities [55]. This herb aids in infection prevention and is beneficial for ailments including anxiety, tension, and exhaustion [56]. Tulsi helps to mobilise mucus, reduce coughing, and provide relief from chest congestion [57]. Antioxidants in this herb aid in detoxification. Tulsi is recommended as a treatment for a variety of diseases, including symptoms like cough, fever, asthma, anxiety, diarrhoea, gastric, cardiac, and genitourinary disorders [58]. Tulsi has antimicrobial, anti-diarrheal, anti-oxidant, anti-inflammatory, hepatoprotective, cardioprotective, reno-protective, analgesic and antipyretic qualities [59]. It defends against harmful chemical-induced injury, boosts antioxidant enzyme activity, and safeguards cellular organelles and membranes by removing damaged free radicals. Tulsi can protect the body from the negative effects of many toxicants [60]. The studies shows that how tulsi can protect against genetic, immunological, and cellular harm caused by pesticides, drugs, and environmental pollutants, hence preventing damage to the liver, kidneys, and brain. Tulsi can shield your family from viral diseases, colds, and coughs when consumed [61]. *Ocimum Sanctum* are extremely ancient herbs with cold potency, fragrant compounds, and antioxidants. Holy basil controls the stress response and boosts resiliency and vitality. Tulsi leaf and its constituent boost immunity in an empty stomach, and it has an immunomodulatory effect on healthy individuals [62]. Tulsi possess excellent immune-enhancing properties that prepare the body against foreign elements like bacteria, viruses, microbes, allergens etc. Thus, it maintains the overall balance in the body [63].

Tulsi fresh leaf extract on steam distillation revealed a change in the humoral immune response in an experiment on albino rats. This change could be attributed to mechanisms like antibody production, the release of substances that cause hypersensitivity reactions, and their impact on target organs. By enhancing cell-mediated immunological reactivity and gamma aminobutyric acid (GABA) ergic pathways, tulsi enhances cellular and humoral immunity [64]. Additionally extracted from the leaf extract were ursolic acid, apigenin, luteolin, apigenin-7-O-glucuronide, luteolin-7-O glucuronide, orientin, and molludistin [65]. It also contains a number of sesquiterpenes and monoterpenes viz., bornyl acetate, β--element, neral, α- and β--pinenes, camphene, campesterol, cholesterol, stigmasterol and β--sitosterol [66]. Tulsi is a powerful herb with numerous therapeutic uses and health advantages. This is simple-to-grow plant, boosts defences and battles harmful germs and viruses [67]. Tulsi is highly valued and has been addressed extensively in Ayurveda. Even contemporary science has acknowledged the majority of Tulsi's advantages.

D. Turmeric (Curcuma longa):

Turmeric is a pungent Asian spice with a fascinating heritage. One of the most notable compounds found in turmeric is curcumin [68]. Turmeric extracts have demonstrated antibacterial and antioxidant properties due to the presence of curcumin, a polyphenolic molecule.

Curcumin's antioxidant properties are therefore due to its phenolic component [69]. For more than 4,000 years, people have used turmeric (*Curcuma longa*) to treat a range of ailments. Through the decrease of various cytoprotective proteins, such as catalase, -glutamylcysteine ligase, glutathione S transferase, glutathione reductase, heme oxygenase , superoxide dismutase, and glutathione peroxidase, curcumin also exhibits indirect antioxidant effects [70, 71]. The polyphenolic chemical curcumin is present in turmeric, this ingredient gives turmeric its antibacterial and antioxidant properties. Therefore, curcumin's phenolic component is what gives it its antioxidant properties [72]. Vitamin C, cineole, tumerone, borneol, zingiberene, d-sabinene, and d-phellandrene are some of the phytochemical components of turmeric. Turmeric contains a variety of chemical substances, such as monoterpenes, sesquiterpene alcohols, and sesquiterpene ketone (e.g., zingeberene). Zingiberene is a component of fresh turmeric, but curcumin is the most important curcuminoid present. Turmeric has an antimicrobial (antibacterial and antifungal) activity, according to previous publications [73,74,75,76]. Turmeric contains additional colouring compounds known as curcuminoids in addition to its volatile oil, which is the root's major component and contains turmerone.

Through the decrease of various cytoprotective proteins, such as catalase, -glutamylcysteine ligase, glutathione S transferase, glutathione reductase, heme oxygenase 1, superoxide dismutase, and glutathione peroxidase, curcumin also exhibits indirect antioxidant effects [77,78]. When combined with higher levels of plasma albumin and glutathione reductase, glutathione peroxidase, and catalase activity, turmeric therapy can lower plasma levels of malondialdehyde [79]. By increasing antioxidant enzymes, scavenging various free radicals, and preventing lipid peroxidation, the aqueous and ethanol extracts of turmeric exhibit notable antioxidant properties [80]. Turmeric suppresses hydrogen peroxide in cells by avoiding lipid peroxidation, as shown by some in vivo experiments on rats [81,82]. The biological functions of Curcuma species and their bioactive substances have been thoroughly investigated through in vitro and in vivo studies [83]. It is known that the Curcuma species and the bioactive compounds found in them have a wide range of pharmacological activities [84]. The bioactive substance curcumin, which has anti-inflammatory properties, is found in turmeric [85]. It is frequently used in Indian cuisine for curries and other foods. It can also be taken as an AYUSH-recommended daily decoction (kadha) made from grated ginger, tulsi, and turmeric to strengthen the immune system [86].

Due to its numerous health advantages, curcumin has drawn attention from all over the world. These advantages seem to be principally mediated through its anti-oxidant and anti-inflammatory processes [87]. The best way to get these advantages from curcumin is to combine it with substances like piperine, which greatly boosts its bioavailability [88]. The primary natural polyphenol present in the rhizome of Curcuma longa (turmeric) and other Curcuma spp. is curcumin (1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione), also known as diferuloylmethane [89]. Due to its antioxidant, anti-inflammatory antimutagenic, antimicrobial [90,91] and anticancer qualities [92,93], anti-mutagenic, and antimicrobial characteristics, curcuma longa has been utilised as a medicine for centuries in Asian nations [94]. Curcumin used in different food items, make its mark on biological systems, and investigations have proven this without a shadow of a doubt. This supports the possibility of using curcumin as a modern nontoxic chemotherapy for a wide range of illnesses [95].

E. Ginger (Zingiber officinale Roscoe):

Since more than 3000 years ago, humans have utilised ginger. Ginger is the rhizome of the *Zingiber officinale* plant and a member of the Zingiberaceae family [96]. It is used as a food additive, flavouring, and spice [97]. One of the most important bioactive compounds in ginger, ginger polysaccharides, have garnered a lot of attention during the past 20 years. Numerous bioactivities, including antioxidant [98], antitumor [99], anti-coagulant [100], and primary structural characterisation, including molecular weight and monosaccharide composition have been documented. Polyphenol curcumin, which also includes lipids, dietary fibre, carbs, vitamins, minerals, polyunsaturated fatty acids, and essential oils, is the plant's primary active component. Numerous clinical investigations have been carried out to assess curcumin's bioactive impact in a variety of inflammatory disorders because of its well-known anti-inflammatory capability. Respiratory diseases can be relieved and prevented by curcumin [101]. Ginger has a long history of being a common spice used in many countries all over the world. The ginger has also been employed as a component of therapeutic processes for the treatment of many different conditions, including malignancies [102], as well as traditional treatments to treat common gastrointestinal system ailments. Ginger's primary components exhibit a range of pharmacological activities that increase the host's defence against infectious diseases by increasing non-specific and specific immunological responses [103]. Ginger contains several natural organic chemicals, including 6-gingerol, 6-shogoal, and 6-paradol.

A lot of research have demonstrated the value of ginger as a therapeutic agent, making it a popular herb today. One cannot completely rule out the possibility that it could be a significant anti-inflammatory and anti-emetic [104]. Ginger is a significant plant that has many therapeutic, ethno-therapeutic, and nutritional benefits. It is frequently utilised in traditional medicine [105]. Ginger is used all over the world. It is believed to provide a variety of health benefits, including those related to the cardiovascular system, inflammation. Ginger is utilised to stimulate the immune system, act as an antioxidant, and encourage growth [106]. The main ingredient in ginger, gingerol, has been isolated and its toxic and pharmacological effects have been investigated [107]. Despite initial evidence seems encouraging, extensive clinical research is necessary to support ginger as a good phytopharmaceutical medication. Different analytical techniques have helped to identify at least 115 different components in both fresh and dried ginger variants. The quantities of shogaols, which are the main gingerol dehydration products, are more plentiful in

dry ginger than in fresh ginger, despite the fact that gingerols, the main component of fresh ginger, are slightly reduced in dry ginger [108]. It was also said to work well as a treatment for cough, cold, nausea, vomiting, food poisoning, and arthritic pain [109]. Ginger's therapeutic and nutritional benefits have prompted scientists to investigate its anti-microbial, anti-oxidant, and anti-cancer qualities [110]. The anti-inflammatory, antifungal, and anti-cancer effects of ginger are well established. Ginger has long been used in traditional medicine to treat a variety of ailments. Ginger is helpful in battling respiratory issues [111]. Ginger is advantageous for increasing immunity because of its high antioxidant content, lowering stress because of its powerful scent and anti-inflammatory qualities, and enhancing blood circulation. The spicy active ingredient in ginger is gingerol, which is also included in allicin, alliin, and ajoene as well as enzymes (allinase, peroxidase, and myrosinase). Antioxidant-boosting chemicals are found in ginger. Together, glutathione peroxidase and superoxide dismutase fight against viral infections in the body [112].

III. CONCLUSION

In this review, we have systematically summarized the medicinal properties of five medicinal plants. Phytochemical compounds of medicinal plants are effective against several diseases and continuing usage of plant products as drugs as an alternative method of treating patients since ancient times. Allopathic medicines do not have a safe role in this regards. Many indigenous drugs have been claimed to have diuretic effect in traditional medicine but they were not much explored. Naturally occurring compounds and derivatives are safer and effective. It important for the modern researchers to give scientific validation for the most common medicinal plants claimed for therapeutic activity to make use of medicinal potential in a more productive and effective way.

Exploring plant anti-inflammatory qualities that can complement or replace current anti-inflammatory allopathic medications is therefore urgently needed. Studies on plants' anti-inflammatory and antioxidant capabilities are important since they can be used to benefit human health. The herbal medicines have a social relevance because they are freely accessible, helpful to the underprivileged and tribal groups. Additionally, it is known that herbal products with a variety of health-promoting properties, such as anti-inflammatory properties, are safe to use with no major adverse effects. Plants are a priceless, extraordinary, and traditional source of medicines that can treat a variety of disorders. The majority of medications used as herbal treatments for health care, illness prevention, and treatment have been derived from plants since ancient times. The majority of plants' medicinal properties have been attributed to their secondary metabolites. A multidisciplinary strategy incorporating botanical, ethnobotanical, phytochemical, and biological approaches is used in plant drug development. According to the WHO, over 75 percent of the world's population relies on traditional medicine. There is a long history of them being used as folk medicines and traditional medicines for medical purposes all throughout the world. As a result, herbal treatments have been utilised for millennia due to their security, effectiveness, lack of negative side effects, and cultural acceptability.

Until now, few sources of information are available for medicinal plants in the literature, and the sources of information in the literature make evident that additional new investigations and scientific reports are necessary for proper dose and formulations. A vast reservoir of selected medicinal plants remains unexplored in terms of phytochemical constituents, as well as pharmacology, and this is the research gap for future studies.

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